

Windows 2000®

File System Features

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**Think of 'NT4 Storage'
as a sedan car....**



**Windows 2000® is
like a Minivan in
comparison...**

**...more Space,
Flexibility**

Not your father's minivan!

...



Overview

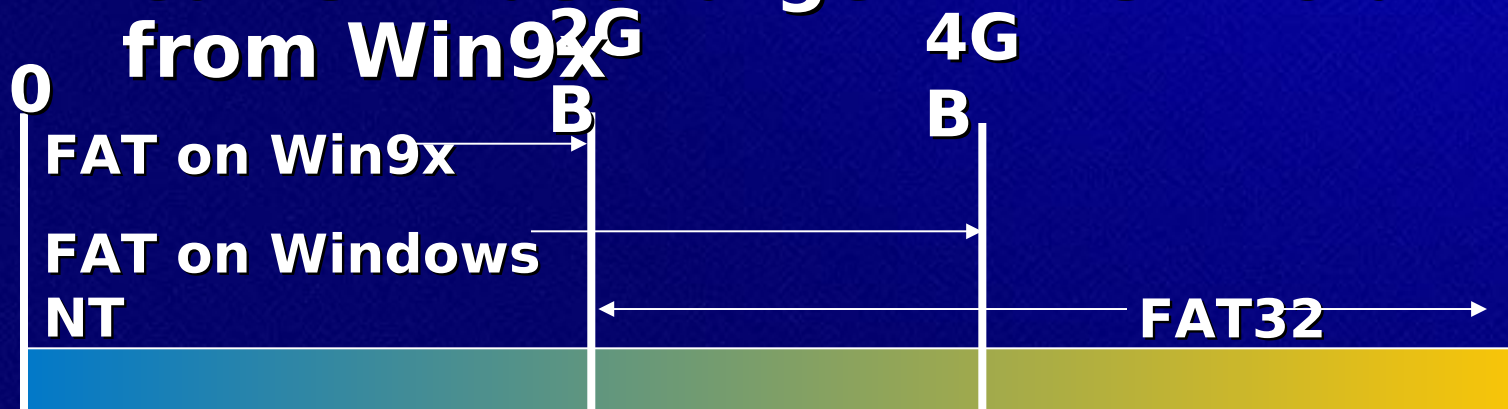
- ◆ **CDFS, FAT are in maintenance mode**
- ◆ **FAT32 filesystem added**
- ◆ **UDF Read support added**
- ◆ **NTFS enhanced in Windows 2000**
 - **Advanced storage features**
 - **Windows 2000 only**

Platform Support

| | Windows | Windows NT |
|--------------|--------------|--------------|
| CDFS | All versions | All versions |
| UDF | Windows 98 | Windows 2000 |
| FAT | All versions | All versions |
| FAT32 | Windows 95 | Windows 2000 |
| NTFS | OSR2 | All versions |
| | -- | |

New FAT32 filesystem

- ◆ Can be used to manage disk volumes 2GB and greater
- ◆ Windows 2000 limits maximum size of new FAT32 volumes to 32GB
- ◆ Can still use larger FAT32 volumes from Win9x



New UDF filesystem

- ◆ **UDF = Universal Disk Format**
- ◆ **The successor to CDFS**
- ◆ **Windows 2000 implementation is read only**
- ◆ **Targeted at CD and DVD media**
- ◆ **Standards: ISO 13346, ECMA 167, OSTA UDF**
- ◆ **Optical Storage Technology Association**
 - **<http://www.osta.org>**
 - **UDF 1.02 (Also in Windows 98), UDF 1.50**
 - **Microsoft will continue to track the evolving UDF standard.**

New NTFS features

- ◆ **On-disk format has changed**
- ◆ **New Disk Quota support**
- ◆ **Enhanced security: EFS**
- ◆ **New Volume Mount Points**
- ◆ **New Change Journal**
- ◆ **Sparse files, Object Ids**
- ◆ **CHKDSK has improved performance**

On-disk format change

- Because of new features, and to simplify code and testing
- ◆ Windows 2000 will automatically upgrade all NTFS volumes to NTFS v5.0 format at first mount. Very quick operation.
- ◆ NT4+SP3 and earlier versions cannot read NTFS v5.0 volumes
- ◆ NT4+SP4 includes new NTFS.SYS that allows limited interop between NT4 and Windows 2000
- ◆ *SP4 NTFS.SYS provided for evaluation and testing only. NOT A LONGTERM DUAL BOOT SOLUTION - no CHKDSK update in SP4.*

Disk Quotas

◆ Features

- Per-user, per-volume
- Based on file ownership (SID)
- Monitor and constrain disk usage
- Remote administration

◆ WYSIWYG

Disk Quotas

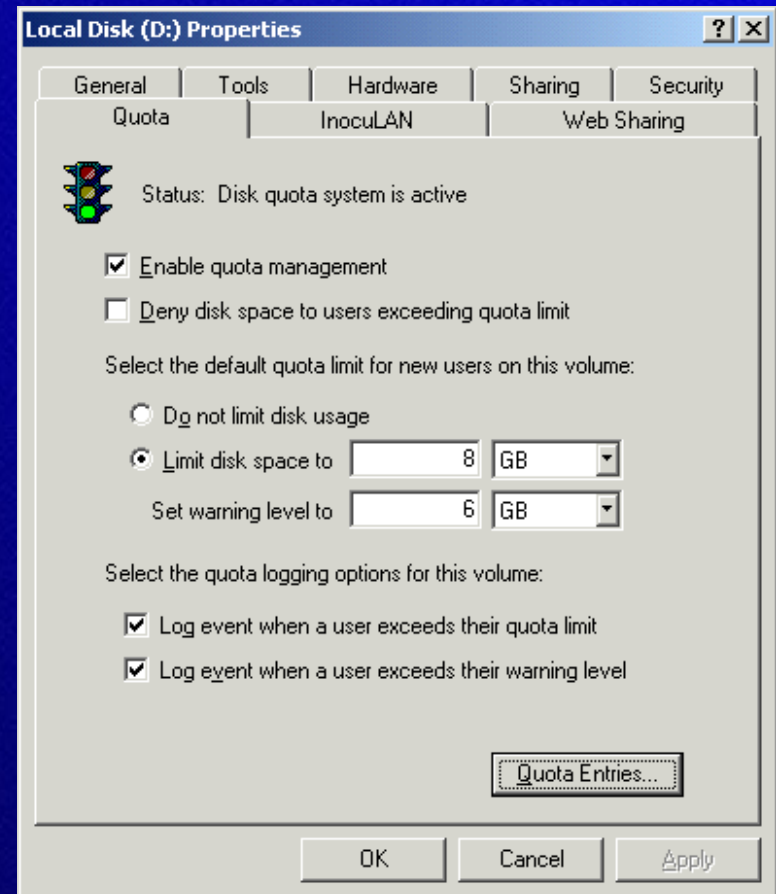
Quotas are accessed from a new 'Quotas' tab on the disk property page

COM Interface:
IDiskQuota

Scripting Interface
available - see end of
DskQuota.h

GUI has rich drag'n'drop

Quota information is IN
the volume - so flexible
for MSCS & SAN



Dynamic volumes

- ◆ **Behavior is increasingly online, non-stop**
- ◆ **Dynamic disks support:**
 - **Grow NTFS volumes without taking the volume offline.**
 - **Create, break and recover NTFS-formatted stripes and mirrors without taking the volume offline.**
- ◆ **Force dismount even with open files**
 - **Supported on both FAT and NTFS**

Encrypted files on NTFS

- ◆ Encrypted File System (EFS) for NTFS
 - Laptop Scenarios
 - Desktop, Server Scenarios
- ◆ Designated 'Recovery Agents' can recover encrypted data for a domain
 - There must be at least one Recovery Agent
 - Recovery keys can be exported as a file and kept physically secure (e.g. floppy).

Encrypted files on NTFS

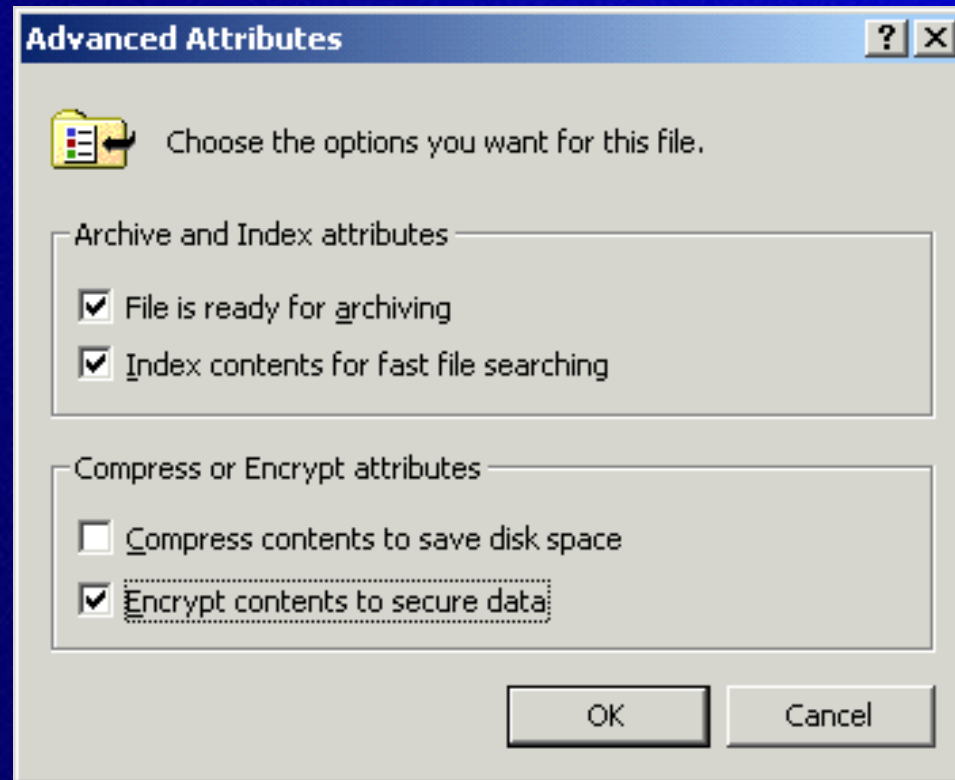
◆ How does it work?

- Every file is encrypted with its own random File Encryption Key (FEK)
- FEK encrypted using the users key. This is the Data Decryption Field (DDF)
- FEK also encrypted using the Recovery Agent's key. This is the Data Recovery Field (DRF)
- DDF and DRF are stored in a stream along with the File.

◆ Not a key escrow scheme.

◆ Implemented in NTFS - not a filter.

Encrypted files on NTFS



- ◆ **Encrypt / decrypt from file/folder property page**
 - **Note that you cannot encrypt and compress**

Volume Mount Points

Can now mount a volume to...

- **a directory on another NTFS volume,**
- **a drive letter,**
- **or both!**
- ◆ **Smart and persistent... GUIDS**
- ◆ **Build and share volumes with storage classes - mirrored, normal, RAID5 etc..**

Improved CHKDSK

- ◆ **Checking is faster, and more scaleable for large directories**
- ◆ **Progress indicator more accurate**
- ◆ **New options to skip index verification and cycle checking**
- ◆ **Generally bigger systems will see the bigger improvements**

Defrag

- ◆ **Provided by Executive Software**
- ◆ **MMC-based GUI**
- ◆ **Base implementation**
 - **Only defragments local volumes**
 - **Manual operation, one volume at a time**
 - **Vendors can still provide enhanced versions**
- ◆ **Operates on all writeable Windows 2000 filesystem (NTFS, FAT)**

The Change Journal

- ◆ **Aid scalability by removing a large class of I/O operations**
- ◆ **Volume-wide change log**
- ◆ **Changes are tracked per-file**
- ◆ **Interesting applications**
 - **Used by the Microsoft Indexing Service**
 - **Used by File Replication Service**
 - **Could be used for Backup, Auditing**
- ◆ **Allows ISVs to build more efficient utilities**

**200MPH, 0-125 in
6.2**



Sparse Files

- ◆ **Files with 'unallocated' gaps in**
- ◆ **Interesting applications**
 - **Sparse arrays**
 - **Dynamically sized queues and logs**
 - **Used for the Change Journal**
 - **Could be used for HSM in future**

Object IDs

◆ Features

- System-wide indexed ID for a file

◆ Used by Link-tracking Service

- Desktop Shortcuts
- OLE Document links
 - Will be resolved even if file moves to another NTFS volume in the same domain

◆ Used by File Replication Service

- Part of DFS

Bulk ACL checking

- ◆ Check this SID against multiple files
- ◆ Used in Indexing Service to check hits against requestors' SID
- ◆ FSCTL will be documented in SDK
 - FSCTL_SECURITY_ID_CHECK

Find Files by Owner

◆ Features

- **Volume-wide scan for files by owner SID**
- **Linear scan (rather than a tree walk)**

◆ Interesting applications

- **What files does user X own?
(admin-oriented)**
- **Cleaning up a user's files (e.g., quotas)**

For More Information

- ◆ Refer to the TechNet website at
 - www.microsoft.com/technet/events/content
- ◆ Relevant white papers
 - “Enterprise Class Storage in Windows 2000®”
 - “Encrypting File System for Windows 2000®”

Deployment...

- ◆ **Do you still need a FAT Volume?**
 - **Recovery console (winnt32 /cmdcons)**
 - **Safe Mode boot**
 - **Last Known Good**
 - **So... 'No'!**
- ◆ **Consider using Volume Mount points**
- ◆ **Encrypted File System (EFS)**
 - **Requires no configuration**
 - **But does require Active Directory for recovery system to work**

Deployment...

◆ Performance tuning...

- **Log File Size.** Try `chkdsk /L:65536` to increase the log file.
- **4KB allocation units (choose at format time).**
 - Any larger and you can't defrag or compress
- **Note that Setup now creates native NTFS volumes.**
- **Defrag those volumes early**

Session Credits

- ◆ **Author:**
- ◆ **Producer/Editor:**

Where do you want to go **today?**

Microsoft®